FINAL SUBMISSION

LAKE CITY ARMY AMMUNITION PLANT
INDEPENDENCE, MISSOURI

ENERGY

ENGINEERING ANALYSIS

EXECUTIVE SUMMARY

Prepared for

The Department of the Army
Omaha District
Corps of Engineers
Contract No. DACA45-80-C-0090

By

Sanders & Thomas, Inc.
An STV Engineers Professional Firm
Consulting Engineers

DEPARTMENT OF THE ARMY
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June 30, 1982

U.S. Army Corps of Engineers
Omaha District
6014 U.S. Post Office and Court House
Omaha, NE 68102

Attention: MROED-MC

Reference: Energy Engineering Analysis
Lake City Army Ammunition Plant
Independence, Missouri

Subject: Energy Engineering Analysis - Final Submission

Contract No.: DACA45-80-C-0090

Our Project No.: 05-4660

Gentlemen:

This letter transmits the Final Submission of the Energy Engineering Analysis for the Lake City Army Ammunition Plant, Independence, Missouri. The Analysis presents energy conservation projects that will enable the plant to meet energy consumption reduction goals, as specified in the Army Facilities Energy Plan.

The Analysis consists of seven components:

- Executive Summary
- Technical Report
- Appendix I: Master Building List
- Appendix II: Energy Conservation Calculations and Data
- Appendix III: Energy Conservation Measures Summaries
- Computer Output
- Project Programming Documents

All comments have been reviewed and incorporated in the report, as appropriate.

This Energy Engineering Analysis is a valuable data base that can be used for the development of additional projects as Army goals are revised and other energy conservation projects become viable.

The assistance that was provided by plant and COE personnel proved invaluable in completing this assignment. We appreciate their cooperation and hospitality.

Thank you for this opportunity to be of service.

Very truly yours,

SANDERS & THOMAS, INC.

David M. Jonik, P.E.
Project Manager

DMJ:bg

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PROJECT ABSTRACT

ENERGY ENGINEERING ANALYSIS
LAKE CITY ARMY AMMUNITION PLANT

This analysis is undertaken to assist the Lake City Army Ammunition Plant (LCAAP) in meeting the goals established by the Army Facilities Energy Plan to reduce energy consumption by 25 percent by 1985.

Projects selected for implementation as a result of this analysis will assist LCAAP to achieve the 1985 goal. Source energy consumed in 1975 was 1,363,000 MBTU's. This was reduced by LCAAP to 1,105,000 MBTU's in 1980 for a 19 percent savings. By combining LCAAP's conservation effort with selected standby projects described in this report, FY 1985 source energy consumption will be 961,000 MBTU's per year or a 29 percent reduction.

Projects are divided into standby and mobilization status. Selected standby projects will save approximately 41,000 MBTU's. Total energy reduction from FY 80 to the end of FY 85 will be approximately 144,000 MBTU's including 103,000 MBTU's from LCAAP's energy conservation effort. The total installed cost of the standby projects is estimated at $1.1 million. If mobilization projects are implemented source energy consumption can be reduced by an additional 59,000 MBTU's. The cost of implementing the mobilization projects is $1.6 million.

USE OF THE REPORT

This Energy Engineering Analysis consists of the main report, three appendices, and a summary of annual energy consumption on a "per-building" basis. The main report identifies the purpose of the study, describes the existing and anticipated energy use trends, and defines and summarizes specific energy conservation projects recommended to achieve the goals stated in the Army Facilities Energy Plan. Appendices I, II and III, and the Annual Energy Consumption Summary include building information, weather data, cost data, and detailed computer-generated and manual calculations for each individual project.

The analysis will enable ammunition plant personnel to identify energy conservation measures and meet Army energy reduction goals.

The report includes:

- Energy consumption by fuel type
- Energy consumption trends
- ECAM projects
- Other potential projects
- Quick-fix management form
- Description of analyzed buildings

In addition, the Analysis is a detailed data base consisting of:

- An analysis of building energy use
- Energy Conservation Measures applied to each analyzed building to be improved
- A set of marked-up prints from the survey indicating the conditions when surveyed

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EXECUTIVE SUMMARY

1.1 PROJECT REQUIREMENT

This engineering analysis is undertaken in order to develop a systematic program of projects that will lead to energy consumption reductions at the Lake City Army Ammunition Plant (LCAAP) without compromising the mission of the plant, and in compliance with all applicable environmental and Occupational Safety and Health Administration regulations. Reduced energy consumption is a stated goal of the Army Facilities Energy Plan.

The projects included in this analysis are grouped into four increments: A - Energy Conservation and Management Program (ECAM) Projects for Buildings and Processes, B - ECAM Projects for Utilities and Energy Distribution Systems, Modified E - Central Boiler System Projects, and G - Minor Construction, Maintenance and Repair Projects not ECAM Qualified.

2.1 PLANT DESCRIPTION

The Lake City Army Ammunition Plant (LCAAP) occupies approximately 3,900 acres in the vicinity of Lake City, Missouri (see Figure 1: Lake City Army Ammunition Plant Location Map). The plant is approximately eight miles east of Kansas City, Missouri, two miles southwest of Buckner, two miles north of Blue Springs, and two miles northwest of Grain Valley. LCAAP has 442 buildings with a total gross building area of approximately 3.16 million square feet (see Figure 2: Lake City Army Ammunition Plant General Site Map).

LCAAP is a Government-owned, Contractor-operated military industrial installation. The Remington Arms Company serves as the plant operator.

The mission of the plant is to manufacture and prooftest small arms ammunition and to maintain facilities and equipment in support of mobilization requirements.

3.1 ARMY FACILITIES ENERGY PLAN

The Army Facilities Energy Plan sets short and long range energy goals for the Army and provides policy and planning guidance for the development of detailed facility energy plans. The Army's energy goals are to:

- Reduce total facility energy consumption by at least 25 percent by FY 1985 and by 50 percent by FY 2000, using FY 1975 as the base year.

- Reduce FY 85 average annual energy consumption per gross square foot of floor area by 45 percent in new buildings compared to FY 1975.

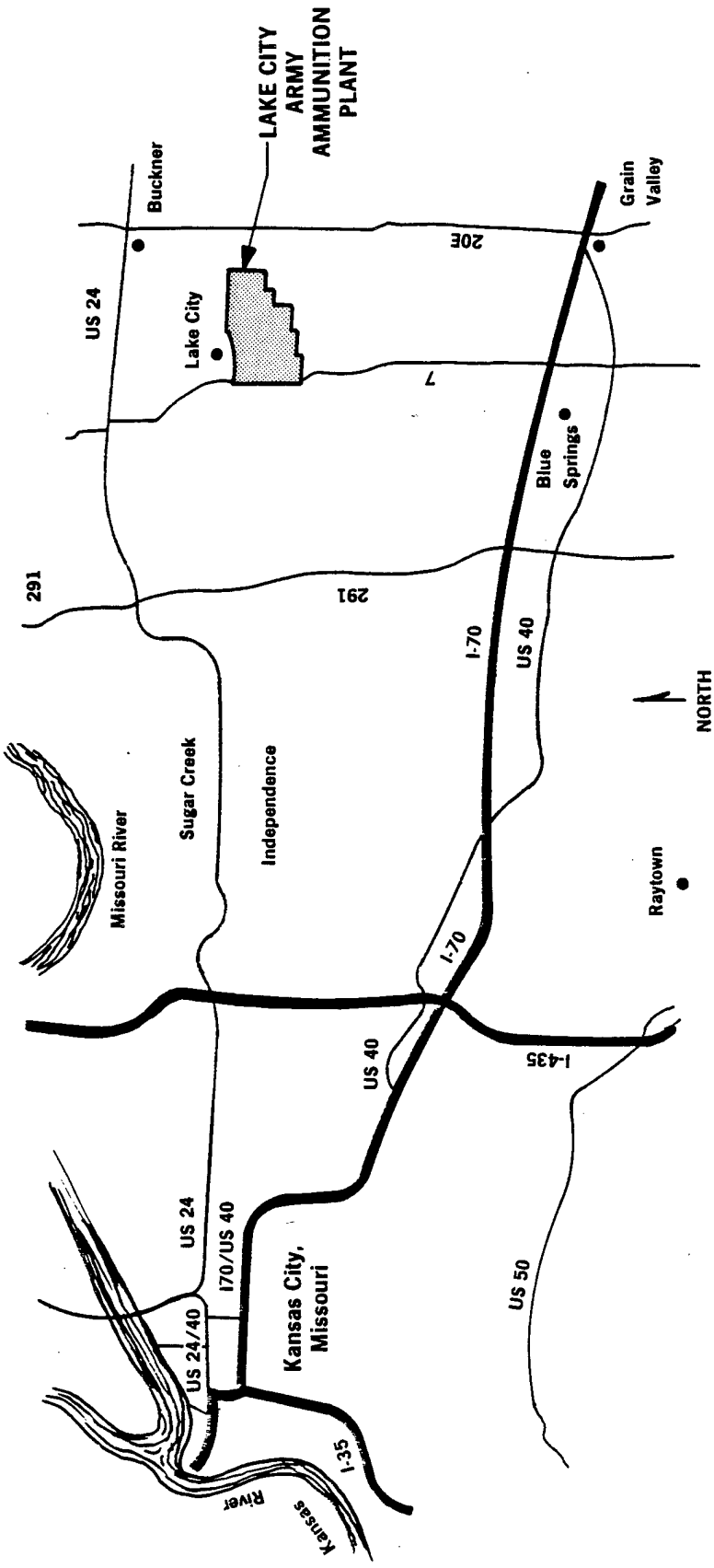

FIGURE 1

LAKE CITY ARMY AMMUNITION PLANT

LOCATION MAP

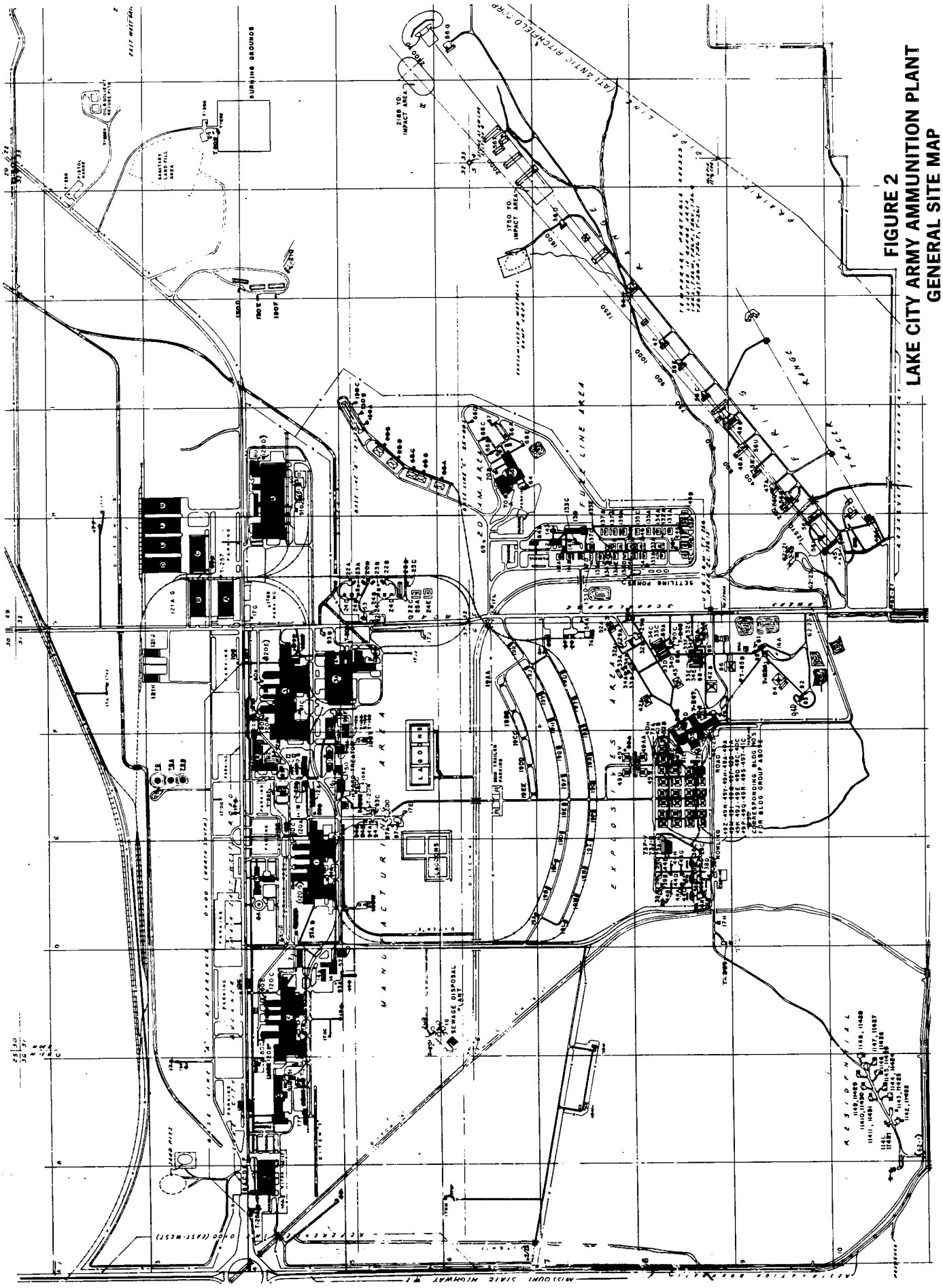

FIGURE 2
LAKE CITY ARMY AMMUNITION PLANT
GENERAL SITE MAP

- Derive ten percent of Army facility energy from coal and alternate fuels by FY 1985.
- Derive one percent of Army facility energy from solar energy by FY 1985.
- Eliminate use of natural gas by FY 2000.
- Reduce facility use of petroleum fuels by 75 percent by FY 2000.

4.1 SOURCE ENERGY CONSUMPTION

Table 1: Source Energy Consumption - FY 1975 and 1979, compares consumption from FY 1975, the base year for the study, with consumption during FY 1979. Fuel consumption over the period dropped as a result of the shutdown of the plant's process facilities. Electrical consumption remained fairly constant.

TABLE 1

SOURCE ENERGY CONSUMPTION
FY 1975 AND 1979

	FY 1975		FY 1979	
Source	Cost ($000)	MBTU's Consumed (000)	Cost ($000)	MBTU's Consumed (000)
Electricity	$ 540	345	$1,012	374
Fuel Oil No. 2	2	1	25	7
Fuel Oil No. 6	760	587	538	278
Natural Gas	194	418	793	653
Propane Gas	40	13	15	5
Totals	$1,536	1,364	$2,383	1,317

5.1 PROJECT EXECUTION

This energy engineering analysis was conducted in four phases:

- Field surveys and data gathering
- Analysis of projects
- Review and verification
- Preparation of Project Programming Documents

5.1.1 Field Surveys and Data Gathering

The field surveys included buildings and process surveys. The surveys were conducted in four areas:

- Architectural - to evaluate such items as wall and roof types, and levels of insulation.
- Mechanical - to evaluate heating, ventilating, and air conditioning systems
- Electrical - to evaluate lighting and building electrical systems
- Distribution - to evaluate plant utility systems

The process surveys addressed the processes conducted at the plant and the various recovery systems in operation.

The distribution surveys covered all plant utility systems including electrical, steam, natural gas, water, and sewage.

The survey phase enabled the identification of energy conservation opportunities and the applicability of energy conservation measures to LCAAP.

5.1.2 Analysis of Projects

After the data gathering phase it was possible to identify potential projects for analysis. These projects were analyzed for applicability to LCAAP and their potential to save energy in relation to their implementation cost.

5.1.3 Review and Verification

LCAAP personnel assisted in the selection of those projects which should be implemented and developed project priorities. All projects were reviewed and verified at the plant in consultation with LCAAP personnel.

5.1.4 Preparation of Project Programming Documents

A DD Form 1391, Detailed Justification and Project Development Brochure have been prepared for each selected ECAM project.

6.1 ENERGY CONSERVATION OPPORTUNITIES

The following energy conservation opportunities were investigated and found to be viable:

Insulation	Consolidate Office Area - Building 6
Storm Windows	Install Strip Doors
Caulking	Install Shower Flow Restrictors
Weatherstripping	Reduce Ventilation Requirements

Install Load Dock Seals	Install High-Efficiency Fixtures
Reduce Glass Area	Repair Leaky Faucets
Reduce Lighting Levels	Prevent Air Stratification
Reclaim Waste Heat from Salem Furnaces	Revise Boiler Controls
Replace Incandescent Fixtures	Condensate Recovery
Install Fluorescent Fixtures	Repair Compressed Air Leaks

The following conservation opportunities were studied but found not viable because of low ECR or lack of conservation opportunity at the plant:

- Small Building Insulation Projects
- Replace Steam Line Insulation
- Install Economizers
- Install Sophisticated Boiler Controls
- Recover Heat from Colt Washers and Dryers
- Use Salem Furnace Waste Heat for Heat Requirement of Salem Dryer
- Erect Vestibules at Employee Entrances
- Replace Gravity Dampers with Motorized Dampers
- Install Task Lighting
- Insulate Interior Partitions
- Heat Destratification - Building 6
- Preheat Makeup Water with Spent Washwater - Building 71
- Install Back Draft Dampers
- Outside Air for Plating Tank Exhaust
- Collect and Reprocess Lead Wire Extrusion Cooling Water - Building 11
- Insulate Chilled Water Lines - Building 65
- Consolidate Cafeteria Space - Building 3
- Insulate Outside Dock Wall - Building 11
- Insulate Air Conditioning Ductwork - Building 10

7.1 PROJECTS SUMMARY

7.1.1 Introduction

A complete listing of all ECAM, Increment "G", and other projects is provided in project number order. This is followed by specific categories of projects arranged in priority order according to descending ECR. A summary of project categories completes this section in Table 7: Summary of Projects.

7.1.2 Selected ECAM Projects

ECAM Projects selected by LCAAP personnel at the Review and Verification Meeting are presented in Table 2: Selected ECAM Projects. Projects are listed in order of descending ECR.

7.1.3 Viable Projects Not Selected for Implementation by LCAAP

Table 3: Viable Projects Not Selected for Implementation by LCAAP, includes those projects not selected for implementation by

LCAAP personnel. These projects were not selected because anticipated procedural changes at the plant would make these projects unnecessary and other projects have accomplished the same purpose. Projects are separated by fiscal year and by standby or mobilization status and listed in order of descending ECR.

7.1.4 Energy Conservation Measures Not Meeting ECAM Criteria

Those portions of ECM Nos. 2, 3, 5 and 7 not included in selected ECAM projects, Increment "G" projects, or viable non-selected projects are listed in Table 4: Energy Conservation Measures Not Meeting ECAM Criteria. Annual MBTU savings, CWE, TIC, and ECR data are included for the unselected portion of each ECM. A complete itemization of individual building projects from which future implementation selection could be made appears in Appendix III.

7.1.5 Increment "G" Minor Construction, Maintenance and Repair Projects

Table 5: Increment "G" Minor Construction, Maintenance and Repair Projects, lists qualifying projects by descending ECR.

7.1.6 Infeasible Projects

Table 6: Infeasible Projects, lists those projects not meeting ECAM criteria.

7.1.7 Projected Energy Trends

Figure 3: Standby Status - Projected Energy Consumption, shows the projected trend in energy consumption over the period FY 1975 to FY 2000. During FY 1984, when the energy projects will be implemented, energy use will be reduced by approximately 41,000 MBTU's per year. Building energy usage per square foot will be reduced from 428 to 337 KBTU's per gross square foot per year during the same period.

TABLE 2
SELECTED ECAM PROJECTS

Project No.	Project Title		Annual MBTU Savings	Annual Cost Savings ($000)	Benefits ($000)	CWE ($000)	TIC ($000)	SAP	BCR	ECR
	FY 84 Standby Status									
5-3	ECAM Project to Insulate Windows, Weatherstrip and Caulk Windows and Doors on Buildings 2 and 3	A	15,700	111	2,100	315	332	2.8	6.3	50.0
5-2.1	ECAM Project to Install Roof and Wall Insulation on Selected Buildings	A	10,300	67	1,339	227	239	3.4	5.6	45.3
5-4	ECAM Project to Insulate Windows and Weatherstrip and Caulk Windows and Doors on Selected Buildings	A	11,900	82	1,568	296	312	3.6	5.0	40.0
5-7.1	ECAM Project to Replace Lighting Fixtures in Various Buildings	A	3,500	18	325	203	214	11.3	1.5	17.3
	Subtotal		41,400	278	5,332	1,041	1,097			

TABLE 3
VIABLE PROJECTS NOT SELECTED FOR IMPLEMENTATION BY LCAAP

Project No.	Project Title	Annual MBTU Savings	CWE ($000)	TIIC ($0000)	SAP	BCR	ECR
	FY 84 Standby Status						
11-1	Expand EMCS to Include Boiler Plant Optimization	13,400	151	159	1.9	6.8	88.7
5-2.5	Install Roof and Wall Insulation on Selected Buildings	23,100	1,423	1,498	9.0	2.1	16.2
	Subtotal	36,500	1,574	1,657			
	FY 84 Mobilization Status						
9-4	Recover Belt and Parts Heat from Salem Furnaces, Buildings 2, 3 and 4	7,150	85	90	1.9	10.2	84.1
9-3	Recover Heat from Salem Hot Water Rinse, Buildings 2, 3 and 4	6,800	122	128	2.8	6.8	55.9
9-1	Recover Heat from Salem Furnaces, Buildings 2, 3 and 4	42,000	1,172	1,234	4.4	4.3	35.8
9-2	Recover Heat from Salem Furnaces, Pilot Project, Building 3	2,800	158	166	8.9	2.1	17.7
	Subtotal	58,750	1,537	1,618			

TABLE 4
ENERGY CONSERVATION MEASURES NOT MEETING ECAM CRITERIA*

ECM No.	Annual MBTU Savings	FY 84 CWE ($000)	FY 84 TIC ($000)	ECR
2	48,800	5,616	5,911	8.7
3	1,300	15.5	16.4	83.5
5	1,700	208	219	8.2
7	3,400	1,033	1,088	3.3

* Those portions of ECM Nos. 2, 3, 5 and 7 not included in selected ECAM projects, Increment "G" projects or viable non-selected projects are summarized in this table.

TABLE 5
INCREMENT "G" MINOR CONSTRUCTION, MAINTENANCE AND REPAIR PROJECTS

Project No.	Project Title	Annual MBTU Savings	Annual Cost Savings ($000)	CWE ($000)	TIC ($000)	SAP	BCR	ECR	Manhours
	FY 84 Standby Status								
5-8	Reduce the Number of Lamps	7,700	40	15	16	0.4	44.8	508	670
12-1	Installation of Strip Doors, Buildings 6, 10 and 11	3,040	21.6	6.2	6.5	0.3	6.5	491	53
12-3	Installation of Strip Doors, Building 121A	5,450	39	16	17	0.4	4.5	341	141
5-5.3	Weatherstrip and Caulk Windows and Doors	1,400	10	20	21	2.0	6.3	71.3	650
13-1	Office Area Consolidation, Building 6	1,600	10	25	25	2.5	8.2	64.1	____
12-2	Ducted Heat Destratification, Buildings 2 and 4	2,970	21	47	50	2.2	8.7	63.2	663
12-4	High Bay Fans for Heat Destratification, Buildings 2, 3 and 4	5,220	38	102	107	2.7	7.1	51.3	450
12-5	Condensate and Steam Pipe Insulation	2,530	18	55	58	3.1	6.2	45.9	1,230
5-2.4	Install Roof and Wall Insulation on Building 51	135	1	6.4	6.7	6.7	2.9	21.1	400
5-2.3	Install Roof and Wall Insulation on Buildings 38A, 38B and 38C	1,000	7.1	48	51	6.7	2.8	20.9	1,440
6-1	Condensate Recovery, 190 PSIG Steam System	1,060	7.5	58	61	7.7	2.5	18.4	____
5-5.4	Weatherstrip and Caulk Windows and Doors	800	6	47	50	7.9	1.6	17.9	1,520
	Subtotal	32,900	219	446	469				
	FY 85 Standby Status								
5-2.2	Install Roof and Wall Insulation on Building 41C	100	0.8	1.2	1.3	1.4	13.9	85.8	____

TABLE 6
INFEASIBLE PROJECTS

Project No.	Project Title	Annual MBTU Savings	CWE ($000)	TIC ($000)	SAP	BCR	ECR
5-6	Install Self-Contained Thermostatic Valves on Radiation	700	226	238	43.8	0.28	3.2

TABLE 7
SUMMARY OF PROJECTS

FY 84	Annual MBTU Savings	TIC ($000)
Selected ECAM Projects (Standby Status)	41,400	1,097
Viable Projects Not Selected (Standby Status)	36,500	1,657
Viable Projects Not Selected (Mobilization Status)	58,750	1,618
Increment "G" Projects (Standby Status)	32,900	469
Total	169,550	4,841
FY 85		
Increment G Projects (Standby Status)	100	1.4

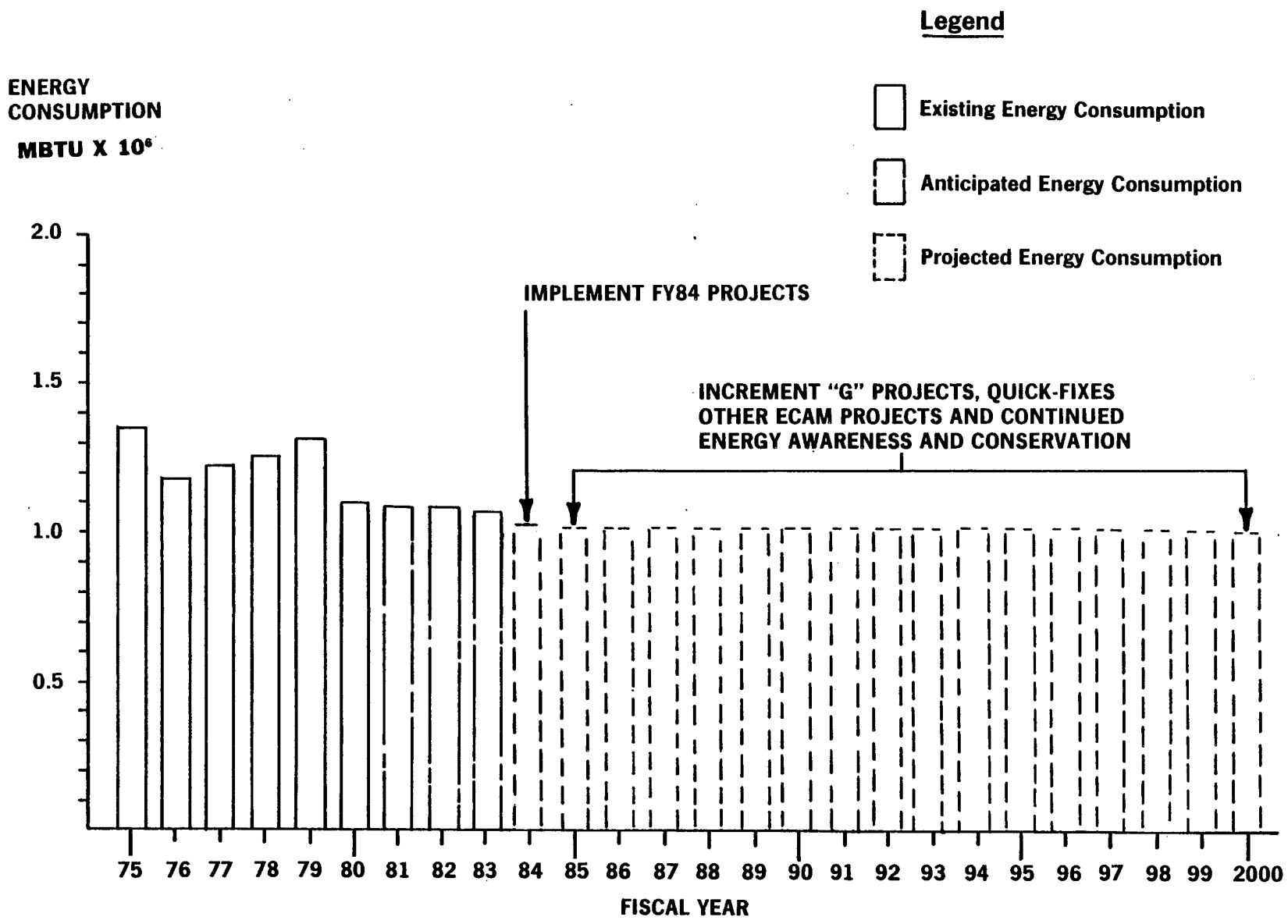

FIGURE 3

STANDBY STATUS — PROJECTED ENERGY CONSUMPTION

DEFINITION OF TERMS

BENEFICIAL OCCUPANCY DATE (BOD)

The date a facility begins to operate.

BENEFIT-TO-COST RATIO (BCR)

The dollar savings realized over the life of the project divided by the non-recurring capital investment (including design). BCR is a measure of project payback. A BCR of 1.0, for example, means that the projects initial capital investment will be recovered over its lifetime.

CURRENT WORKING ESTIMATE (CWE)

The project installation cost escalated to the year the project is programmed for implementation. Installation costs are non-recurring and include all labor and material, contractor costs, bond, contingency, SIOH, and escalation. Design costs are not included and must be added to the CWE to develop the total project cost.

ENERGY-TO-COST RATIO (ECR)

The MBTU's per year saved divided by the non-recurring capital investment (excluding design). ECR is a measure of the amount of energy savings per thousand dollars of required capital investment.

SIMPLE AMORTIZATION PERIOD (SAP)

The project capital investment divided by the yearly savings. This yields the period of time required to recover the initial capital investment.

TOTAL INSTALLED COST (TIC)

The sum of the CWE and the design costs.